Synopsis of proposed Ph.D. research work

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Title of the proposed thesis: Physicochemical Studies on Interaction of Biopolymers with Small Molecules and Surfactants

The present doctoral work aimed with several and multi-disciplinary objectives which are classified into two parts, first portion contain synthetic organic chemistry, photo-physical and computational characterization of the synthesized molecule, its binding interaction with calf thymus DNA, biological activity and in the second portion special emphasis is given on the study of the applications of various surfactants in the field of drug delivery.

From the last few decades, medicinal chemistry, has undergone a enormous change in terms of research, introduction and therapeutic applications of newer molecules extracted mostly from synthesis. A further height of achievement was reached when these pharmacologically active molecules were tagged with biomacromolecule. Whereas natural molecules like, chromones, flavonoids, coumarins etc. are also known to participate in wide range of biological activities, and have been found to affect bio-mechanisms. Apart from the bio-molecules extracted from the natural sources, there are number of other molecules too which are not found in natural sources.

The small molecule/drug-surfactant interaction studies in presence of biopolymer have many fold applications in drug delivery, food industry, pharmaceutical industry and analytical biochemistry. To explore the small molecule/drug-surfactant interactions, determination of binding isotherms is essential, which yields the binding stoichiometry. The techniques used in these binding studies include spectroscopy , potentiometry, cyclic voltammetry, circular dichroism, surface tension measurements and so forth.

These anomalous activities manifested by the surfactant or small molecule-biopolymer complexes are assumed to be due to the following reasons:

1) Small molecule-biopolymer complexes have better hydrophobic or hydrophilic properties than the free small molecule which help in drug transport through the tissues.

2) Small molecule with variable tautomeric forms offer photophysical properties and a possibility for tailoring substrate to target DNA.

3) An understanding of how biopolymer interact with amphiphilic molecules that shield their surface is crucial for experimental design and biophysical characterization of biopolymer in solutions. A

quantitative understanding of these processes has fostered tremendous interest owing to their ability to furnish new insights into the development of structure-based molecular design strategies. These strategies can produce crucial diagnostic information toward understanding the specific functional and/or stability of the biopolymer, development of pharmaceutical drugs targeted to the specific receptors, etc.

Inspired by these potentials, we intend to prepare suitable small molecule/drug and their derivatives, to study their interactions with bio-molecules like, DNA. For this purpose molecule from the families of flavonoids, thiopyrimidines, thiopurins, quinoline and sulphoamids are preferred as they contain various donor atoms with ability to form weak bond like hydrogen bond. Under this research work, small/drug molecule with the natural or derived bio-ligands will be prepared and studies on the interactions of these compounds with DNA combined with the molecular docking studies will be carried out to help in designing effective, low toxic and target specific therapeutic agents.

Objectives:

1) Searching for suitable natural drug/small molecule or to prepare suitable derivatives of those molecules that can have pharmacological activities.

2) Synthesis of natural drug/small molecule, experimental and computational characterization with the help of NMR, IR, Mass, UV-vis, emission spectroscopy and gaussian suits of programme.

3) Study their interactions with other reactants that may reveal its antioxidant, antimicrobial, antifungal and antiviral activities.

3) To compare the reactivity of synthesized drug composites with those of free drug.

4) To study the interactions between the small molecule that exhibit drug properties with DNA. The intercalation mode of the small molecule induces significant unwinding, stiffening and lengthening of the DNA helix. Thus small molecule based drugs may be used as structural probe for DNA or diagnostic agents.

5) To understand the possible mechanistic pathways of the action the small molecule with bio molecule.